



Towards more sustainable Water, Sanitation and Hygiene (WASH) projects in Magway Region, Myanmar

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Abstract

Clean water and sanitation are essential for human development. Governments, international and national aid organizations have implemented water, sanitation, and hygiene (WASH) projects worldwide, notably in low- and middle-income countries. However, the majority of such projects experience failure. As a result, 2.4 billion people worldwide are deprived of improved WASH services. Research revealing how WASH projects can be sustained and which factors need to be considered is crucial. Despite the gap and its importance, existing studies on the sustainability assessment of WASH projects are limited. This study attempted to assess and compare the sustainability of WASH projects in Myanmar that used the Community Led Total Sanitation (CLTS) and Participatory Hygiene and Sanitation Transformation (PHAST) approaches with the “Sustainability Check” developed by The United Nations Children’s Fund (UNICEF). This research also evaluated the extent to which WASH projects contributed to the Myanmar National WASH Strategy. The study results show that both CLTS and PHAST project operations fully met the sustainability standards regarding accessibility and intra-village equity. Other sustainability indicators, such as water quality, use of sanitation facilities, and handwashing facilities, were at or above 85% and had already met the 2025 national targets. In contrast, handwashing practices have reached the 2030 national targets. The findings revealed that technical factors, institutional factors (at the community level), social, financial, and sanitation factors contributed to WASH project sustainability. The results also highlight the need for strengthening collaboration with local government to ensure that communities receive post-implementation support from local authorities, to encourage community participation and foster

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sense of ownership, to empower community-based bodies for O&M and monitoring of water and sanitation facilities, to integrate appropriate behavioral change activities, and to align with the National WASH Strategy. This study would be beneficial for WASH practitioners to ensure the inclusion of factors that support sustainability in the execution of future WASH projects.

Graphical abstract



Keywords Water, Sanitation and Hygiene (WASH) · Sustainability · Community Led Total Sanitation (CLTS) · Participatory Hygiene and Sanitation Transformation (PHAST) · National WASH Strategy

1 Introduction

Clean water and sanitation are crucial for human development (UNDP, 2006). They are fundamental requirements for raising the capacities of people. Water and sanitation access is critical because they are both basic human rights and essential factors for human development (UNDP, 2006). Following the Millennium Development Goals (MDG), 2.4 billion people worldwide remain without access to improved water, sanitation, and hygiene (WASH) infrastructure (WHO/UNICEF, 2015). In Myanmar, a large portion of the population lacks access to clean water and adequate sanitation, while more than 1160 children under the age of five die every year from illnesses related to poor water and sanitation (WaterAid, 2019). Clean water, basic toilets and good hygiene are essential for children's development and survival. Without access to these, many children's lives in Myanmar are jeopardized: over 4 million (25 percent of Myanmar's children) are forced to live in houses that lack improved sanitation facilities (UNICEF, 2018). Access to safe water and sanitation is important for human health and the socio-economic development of the country (Montgomery & Elimelech, 2007).

Since 2008, following the Nargis Cyclone, a significant number of non-governmental organizations (NGOs), both local and international, have come to Myanmar for emergency response and to deliver assistance for the rehabilitation of water and sanitation facilities (Meehan, 2011). These NGOs have been instrumental in helping to improve the water, sanitation, and hygiene requirements of Myanmar. Despite significant progress in the water and sanitation sectors in previous years, some townships in the dry zone of Myanmar still have water and sanitation issues (Meehan, 2011). According to statistics from the 2015 national census, 26.7% of the rural population in Yesagyo and Myaing Townships still relied on unimproved water

sources. There were no toilet facilities for 31.5% of the rural population in Myaing and 11.6% of the rural population in Yesagyo Township (Ministry of Immigration & Population, 2015). Thus, in 2014, Myanmar Health Assistant Association (MHAA) implemented WASH projects in rural areas of Myaing Township (MHAA, 2015) and in 2016, UN-HABITAT operated WASH projects in rural areas of Yesagyo Township (UNHABITAT, 2016). MHAA utilized the CLTS approach to implement the project, while UN-HABITAT used the PHAST approach. CLTS is an integrated sanitation promotion approach used in WASH projects to achieve and maintain a community's open defecation-free (ODF) status (Nabunnya & Nabemb, 2012). It emphasizes collective community behavior rather than individual behavior to determine the best option for the community to establish a hygienic community that will benefit all members (Kar & Chambers, 2008). The benefits of CLTS include cost-effectiveness, sustainability, social cohesion, the growth of a sense of community ownership and empowerment, and the emergence of natural community leaders (Nabunnya & Nabemb, 2012). PHAST is a community-based approach to promoting hygiene practices, sanitation improvements, and community management of water and sanitation infrastructure (Warner & Seremet, 2008). The PHAST approach has seven steps: problem identification, problem analysis, planning solution, choosing options, planning for new facilities and behavior change, monitoring and evaluation planning, and participatory evaluation (WHO, 1998). As each step necessitates community participation, the facilitator's role is critical, and the facilitator must be skilled.

The main difference between these two approaches lies in their primary focus and strategies. CLTS emphasizes the behavioral change aspect of sanitation and attempts to achieve open defecation-free (ODF) communities through community mobilization and empowerment. It employs methods such as triggering sessions, where communities collectively analyze and confront the negative impacts of open defecation, leading to the spontaneous construction and use of latrines (Kar & Chambers, 2008). On the other hand, PHAST focuses on promoting hygiene practices and behavior change by actively involving the community in identifying and addressing their hygiene-related challenges. It utilizes participatory methods, such as demonstrations and group discussions, to raise awareness, improve knowledge and encourage the adoption of proper hygiene behaviors (Warner & Seremet, 2008). While both approaches aim to improve sanitation and hygiene practices, CLTS primarily targets ending open defecation, while PHAST focuses on overall hygiene improvement. CLTS emphasizes community empowerment and triggering behavior change, whereas PHAST focuses on participatory methods and knowledge sharing.

The CLTS approach gained popularity following successful implementation in Bangladesh, India, Indonesia, Pakistan, Kenya and some areas of Uganda (Institute of Development Studies (IDS), 2011). The PHAST approach received widespread recognition after operating effectively in Zimbabwe, Botswana, Uganda and Kenya (WHO, 1998). CLTS and PHAST are common and widely used approaches in Myanmar, where international and national non-governmental organizations account for a large proportion of WASH projects (MIMU, 2019). According to reports from WASH organizations, CLTS and PHAST approaches produced better results than communities had achieved during the project implementation period and at the end of the projects. According to Warner and Seremet (2008), community participation-based programs are more likely to succeed than other programs that have already given solutions (Warner & Seremet, 2008). However, there is still a lack of evidence, particularly for CLTS and PHAST projects. Many WASH studies have been conducted, including reviewing the effectiveness of ongoing WASH projects, developing sustainability frameworks, assessing the sustainability of other community participation approaches or only CLTS approaches, and examining the relationship between WASH and its WASH-related problems or social issues (Clarke et al., 2014; Crocker et al.,

2017; Jain et al., 2019; Muhumed, 2013; Taylor, 2013). Nonetheless, to the best of the authors' knowledge, no study has demonstrated the impacts and sustainability of CLTS and PHAST approaches. In the earlier research, the authors attempted to evaluate the sustainability status of PHAST projects in the Yesagyo township by comparing them with the situation of the communities after the project was completed (Win et al., 2021). The previous paper focused solely on the PHAST project areas, considering 12 factors that supported water sustainability and 11 factors that supported sanitation sustainability. The results of the CLTS projects are included in this study, and a sustainability comparison was made between the CLTS and PHAST approaches (Win et al., 2021). In this context, sustainability refers to the "existence of long-term impacts of the WASH projects in communities." This work was performed with two objectives to fill this void.

- To assess and compare the sustainability status of WASH projects in Myanmar that were implemented using CLTS and PHAST approaches.
- To examine how well the preceding WASH project's implementation complied with Myanmar National WASH Strategy.

2 Methodology

In order to select the appropriate sustainability assessment tool for this study, the authors conducted a thorough literature review of the available sustainability assessment tools for WASH projects. According to Schweitzer et al. (2014), there were 25 sustainability tools for measuring the sustainability of water, sanitation, and hygiene projects. These tools can be categorized into project or program, sector, technology or infrastructure, and others such as basin, community, and organization (Schweitzer et al., 2014). Project or program tools are designed to measure sustainability at the project intervention level, while sector tools focus on assessing sustainability at the broader WASH sector level. Technology or infrastructure tools aim to evaluate the sustainability of specific infrastructure or technologies organizations use. The remaining tools assess sustainability at the level of river basin projects or organizational self-assessment. The 25 sustainability assessment tools, along with their codes and levels, are detailed in the following Table 1.

Since this study aimed to assess the impacts of WASH projects after the implementation period, tools explicitly developed for WASH projects at the project level were initially selected, and tools intended for other types of analysis were excluded. Table 2 provides information on the 20 excluded tools and the reasons for their exclusion.

From the remaining five tools, the tool used in this study was selected based on the following five criteria:

1. Addressing all three components of WASH (water supply, sanitation, and hygiene behaviors).
2. Including indicators that can measure the sustainability of WASH in schools and health facilities.
3. Providing sustainable aspects and factors to determine project sustainability.
4. Offering indicators to measure these sustainable factors.
5. Enabling collection of all required data from project areas and respective WASH service providers.

Table 1 The 25 sustainability assessment tools, their codes and levels (Schweitzer et al., 2014)

No	Tool codes	Name of the tools	Level of the tools
1	ST-WASH-1	Sustainability Assessment Tool	Project or program level
2	ST-WASH-2	Gender Analysis Snapshot	Project or program level
3	ST-WASH-3	Governance into Functionality Tool	Project or program level
4	ST-WASH-4	Local Government IWRM Support Assessment	Project or program level
5	ST-WASH-5	WASH Life-Cycle Assessment	Project or program level
6	ST-WASH-6	Sustainability Monitoring Framework	Project or program level
7	ST-WASH-7	WASH Cost Tool	Project or program level
8	ST-WASH-8	Planning-Oriented Sustainability Assessment	Project or program level
9	ST-WASH-9	Sustainability Check	Project or program level
10	ST-WASH-10	Sustainability Index Tool	Project or program level
11	ST-WASH-11	Tool for Planning, Predicting and Evaluating Sustainability	Project or program level
12	ST-WASH-12	Methodology for Participatory Assessment	Project or program level
13	ST-WASH-13	WASH Sustainability Sector Assessment Tool	Project or program level
14	ST-WASH-14	Water, Sanitation and Hygiene Bottleneck Analysis Tool	Sector level
15	ST-WASH-15	Sub-Sector Scorecard	Sector level
16	ST-WASH-16	Enabling Environment Assessment	Sector level
17	ST-WASH-17	Sector Wide Investment and Financing Tool	Sector level
18	ST-WASH-18	Rural Water and Sanitation Information System	Sector level
19	ST-WASH-19	Check Up Program for Small Systems	Sector level
20	ST-WASH-20	Financing for Environmental, Affordable and Strategic Investments that Bring on Large-scale Expenditure	Technology or infrastructure level Technology or infrastructure level
21	ST-WASH-21	Technology Applicability Framework and Technology Introduction Process	Technology or infrastructure level
22	ST-WASH-22	Road Map for Integrated Water Resource Management (IWEM) in River Basins	River basin level
23	ST-WASH-23	Sustainability Snapshot	Community level
24	ST-WASH-24	Water for Life Sustainability Rating	Organizational level
25	ST-WASH-25	Sustainability Self-Assessment	Organizational level

Table 2 The excluded tools and the reasons for their exclusion

No	Excluded tools	Reasons for exclusion
1	ST-WASH-2	Focus on gender analysis
2	ST-WASH-3	Focus on governance, environmental protection, and risk management
3	ST-WASH-4	Only focus on integrated water resources management
4	ST-WASH-7	Focus on expenditures
5	ST-WASH-8	Only focus on water related projects
6	ST-WASH-11	Not accessible anymore
7	ST-WASH-12	Only focus on the participation of stakeholders
8	ST-WASH-13	Sector Tool, it does not focus on projects
9	ST-WASH-14	Sector Tool, it does not focus on projects
10	ST-WASH-15	Sector Tool, it does not focus on projects
11	ST-WASH-16	Sector Tool, it does not focus on projects
12	ST-WASH-17	Sector Tool, it does not focus on projects
13	ST-WASH-18	Sector Tool, it does not focus on projects
14	ST-WASH-19	Technology or Infrastructure Tool
15	ST-WASH-20	Technology or Infrastructure Tool
16	ST-WASH-21	Technology or Infrastructure Tool
17	ST-WASH-22	River Basin Tool
18	ST-WASH-23	Community Tool
19	ST-WASH-24	Organizational Tool
20	ST-WASH-25	Organizational Tool

The Sustainability Check fulfilled all of these criteria and, therefore, was chosen as the tool for this study. The comparison of the five sustainability assessment tools against the selection criteria is presented in Table 3.

Sustainability Check was developed by UNICEF to assess the sustainability of WASH facilities, services, and behaviors at various levels. In recent years, UNICEF conducted over 35 sustainability checks to monitor the long-term viability of WASH projects. Based on previous experiences, the Sustainability Check was developed in 2008 and initially applied in Malawi and Mozambique. Subsequently, sustainability checks were conducted in sub-Saharan Africa and Asia. The Sustainability Check has been widely applied in previous works, including developing national Sustainability Action Plans and collaborations between UNICEF, WaterAid, and the Water Supply and Sanitation Collaborative Council. These partnerships have utilized the Sustainability Check to assess and enhance

Table 3 Comparison of the five sustainability assessment tools against the selection criteria

Tool	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Criterion 5
ST-WASH-1					✓
ST-WASH-5			✓		
ST-WASH-6					✓
ST-WASH-9	✓	✓	✓	✓	✓
ST-WASH-10				✓	✓

the sustainability of WASH initiatives, demonstrating its practicality and effectiveness in evaluating and improving project sustainability (UNICEF, 2017). This comprehensive assessment tool evaluates the current state of sustainability and examines the underlying factors crucial to sustaining WASH services (UNICEF, 2017). Therefore, the sustainability of CLTS and PHAST projects was determined using the indicators of the Sustainability Check. Using the same method, the factors supporting sustainability were also evaluated. Even though all indicators were measured, only those demonstrating compliance with Myanmar National WASH Strategy were compared during the sustainability comparison section. Sustainability factors were assigned high, medium, and low scores based on the percentages reached for each factor: 80–100%, 50–79%, and < 50%, respectively.

2.1 Study sites, sample size and data collection techniques

Myanmar is located in Southeast Asia and shares its border with Bangladesh and India to the northwest, China to the northeast, Laos to the east, and Thailand to the southeast (Aung et al., 2023). According to the 2014 National Census, Myanmar has an estimated population of over 51 million. Myanmar has abundant water resources, which varies depending on seasons and regions. The use of drinking water sources also varies depending on regions and accessibility (Asian Development Bank, 2013). Water resources, including surface water (rivers, streams) and groundwater, are important for providing water for households. The most common drinking water sources in rural areas are protected springs, deep tube wells, hand-dug wells, rainwater harvesting, rivers and streams (Thein, 2019). The availability and quality of drinking water sources in rural areas of Myanmar can be influenced by various factors, including geographical location, hydrogeology, and seasonal variations. Water consumption habits in Myanmar differ depending on urban or rural areas, access to safe drinking water and cultural practices. In areas where access to clean drinking water is limited, various treatment methods are used, including boiling water, using water filters, or using water purification tablets. Due to periodic water scarcity and limited access to clean water, water conservation practices are applied. In rural areas, traditional water storage methods such as clay pots or jars are still in use to keep water cool and accessible for drinking (Nagpal et al., 2020).

This study aims to compare the sustainability of CLTS and PHAST projects, which are widely utilized approaches in Myanmar. Initially, the authors reviewed the locations where these projects were carried out. It was found that these projects were implemented throughout Myanmar (MIMU, 2020). The authors conducted the study in the same region as contextual backgrounds can influence project sustainability. In addition, this study needed the collaboration of the organizations that implemented the projects to obtain their final reports for preliminary studies. Since this study was conducted during the COVID-19 outbreak, obtaining approval for data collection was essential. After careful consideration, the Magway region was selected for the study. The region was chosen because it had areas where both CLTS and PHAST were implemented, the respective organizations (UN-HABITAT and MHAA) agreed to participate in the study, and permission to access the project areas was granted.

Magway region is in the central dry zone and experiences acute water shortages annually (Meehan, 2011). The region comprises five districts and 25 municipalities, as seen in Table 4. Based on the 2014 National Census data, the population of the Magway Region was approximately 3.917 million (Ministry of Immigration & Population, 2017).

Table 4 Districts and respective municipalities under Magway region

Name of Region	Name of districts	Name of municipalities
Magway region	Gangaw	1. Gnagaw
		2. Htilin
		3. Saw
	Magway	1. Magway
		2. Yenangyoung
		3. Chauk
		4. Natmauk
		5. Myothit
		6. Taungdwingyi
	Minbu	1. Minbu
		2. Pwintphyu
		3. Salin
		4. Saytottara
		5. Ngape
	Pakokku	1. Pakkokku
		2. Yesagyo
		3. Myaing
		4. Pauk
		5. Seikphyu
	Thayet	1. Thayet
		2. Aunglan
		3. Kamma
		4. Mindon
		5. Minhla
		6. Sinpaungwe

Within the Magway region, UN-HABITAT implemented WASH projects using the PHAST approach in 35 villages in Yesagyo Township, Pakokku District, from 2016 to 2018 (UNHABITAT, 2016). MHAA implemented WASH projects using the CLTS approach in 55 villages in Myaing Township, Pakokku District, from 2014 to 2015 (MHAA, 2015). There were ongoing CLTS projects in other townships of the Magway region. However, the study focused on assessing the implemented projects' sustainability. Thus, the PHAST project areas in Yesagyo Township and the CLTS project areas in Myaing Township were selected as the study sites. These two townships are adjacent and have similar geographical backgrounds. The sample size for our study was determined based on the sample size of the end-line survey conducted by UN-HABITAT. UN-HABITAT conducted an end-line survey in 14 villages in Yesagyo Township, with a sample size of 20 households per village. MHAA did not conduct an end-line survey, so the same sample size as the PHAST project areas was used. Therefore, the sample size for the study was 14 villages from each township, and a total of 28 villages were initially selected to perform key informant interviews (KII). Key informants for the study were the village leaders and members of the WASH committee. The selection of villages was based on the feasibility of data collection. Only those villages were selected where village leaders allowed the study to be conducted. Twenty households from each village, a total of 560 households, were randomly selected to carry out household interviews. Any household member within the age range of 18 to 60 years could participate in the household interviews. KII and household interviews were conducted using semi-structured questionnaires to gather quantitative and qualitative data. Overall information about the villages, including population data, the

number of households, the number of water sources, details about the WASH committees, information regarding water resources, the protection of water resources, the water tariff system, the open defecation-free status of the villages, and activities supported by NGOs and the local government were obtained from the key informants. The remaining information was gathered from the household interviews. The data collection process lasted two months, from December 2020 to January 2021.

2.2 Sustainability indicators

The key dimensions to measure the sustainability status of water supply in Sustainability Check are accessibility (AF 1), functionality (AF 2), reliability/continuity (AF 3), reliability/seasonality (AF 4), intra-village equity (AF 5), water quality (AF 6) and catchment protection (AF 7) (UNICEF, 2017). Similarly, areas of focus used to determine the sustainability of sanitation and hygiene are maintenance of ODF status (AF 8), use of sanitation facilities (AF 9), handwashing facilities (AF 10) and handwashing practices (AF 11) (UNICEF, 2017). The indicators for measuring the areas of focus are summarized in Table 5.

According to the Sustainability Check, there are sustainability factors that can have an impact on the sustainability status. Therefore, the existence of sustainability factors was evaluated using semi-structured questionnaires developed based on the suggested indicators of the Sustainability Check. Sustainability factors for water supply and sanitation and the indicators to measure the sustainability factors are listed in Table 6.

Table 5 Indicators for each focus area of sustainability (UNICEF, 2017)

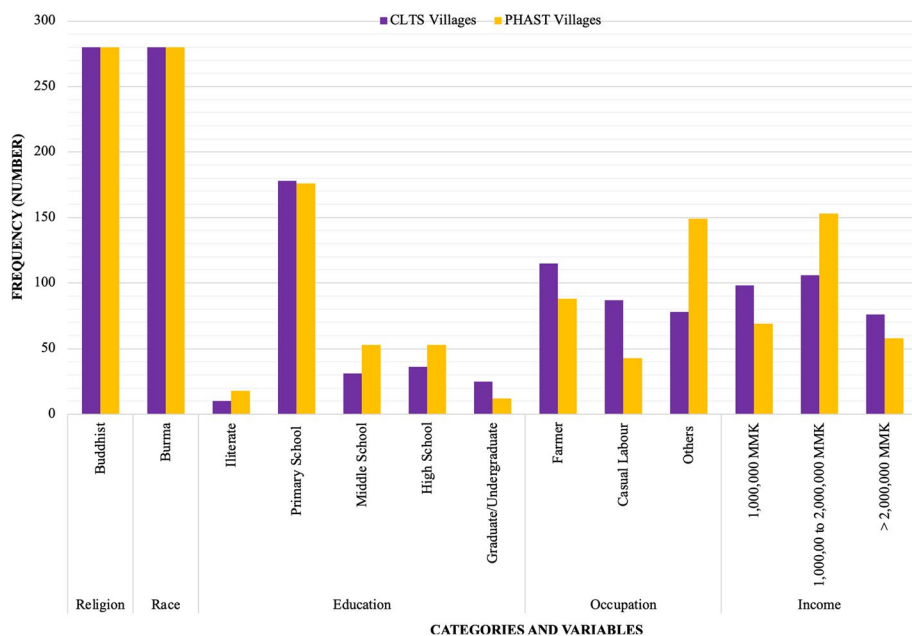
Areas of focus	Indicators
AF 1: Accessibility	Percentage of water points within 30 min round-trip (including queuing) to collect water
AF 1: Accessibility	Percentage of village with users per water points ratio that complies with national standards
AF 2: Functionality	Percentage of water points functioning at the time of visit
AF 3: Reliability/continuity	Percentage of average number of mechanical breakdowns per year
AF 4: Reliability/seasonality	Percentage of water points that have been dried up for at least 1 month
AF 5: Intra-village equity	Percentage of households that have at least one functional water point within 200 meters
AF 6: Water Quality	Percentage of households that obtain quality water complies with national standards
AF 7: Catchment Protection	Percentage of protected water points from contamination
AF 8: Maintenance of open defecation-free (ODF) status	Percentage of certified open defecation-free (ODF) villages
AF 9: Use of sanitation facilities	Percentage of households that have access to own latrines
AF 10: Handwashing facility	Percentage of households that have soap and water near the vicinity of latrines
AF 11: Handwashing practice	Percentage of household respondents that report they wash their hands at critical times

Table 6 Indicators for sustainability factors (UNICEF, 2017)

Sustainability factors	Indicators
SF 1: Preliminary studies and planning conducted for siting of the water points	Percentage of villages where planning and siting of water points with WASH committee
SF 2: Quality of design, construction, and quality control over the process	Percentage of water points constructed by professional constructor and supervised by staff and WASH committee during construction
SF 3: Local community participation in decision making throughout the process	Percentage of villages with WASH committee involvement in allocating budget and monitoring process
SF 4: Local water resources are properly managed and protected	Percentage of villages with responsible person in place for decision making and conflict resolution regarding allocation of water resources
SF 5: Safety of the water sources from pollution and contamination	Percentage of villages with presence of water safety plan
SF 6: Unforeseen changes in demography political situation	Percentage of water points with sudden change in the number of users
SF 7: Post implementation support from local authorities	Percentage of villages that receive technical support or money from local authorities or NGOs
SF 8: Financing mechanism locally in place	Percentage of villages with presence of water tariff system
SF 9: Safety of water points	Verification of water safety plan is carried out once a year
SF 10: Effectiveness and capacities of water management committee	Percentage of villages where tariff is effectively/regularly collected and properly managed
SF 11: Accessibility and quality of inputs and technicians for repairing water points when needed	Percentage of water points with access to technicians and spare parts within 48 h or national service standards
SF 12: Presence of water to build, repair or clean the latrine	Percentage of households that declare having adequate access to water to clean latrine
SF 13: Resilient construction of latrines	Percentage of latrines that were repaired/rebuilt within 1 month after filling up or getting damaged
SF 14: Willingness to pay prioritization of sanitation	Percentage of households that report sanitation as a high priority
SF 15: Affordability of standard household latrines	Percentage of households that report that they can afford latrine construction
SF 16: Adequate operation and maintenance of latrines	Percentage of latrines in good condition
SF 17: Existence of social norms supporting ODF status	Existence of (written or unwritten) local by-laws on the adherence to ODF with corresponding sanctions or rewards
SF 18: Quality of triggering process	Participation of a high percentage of community members from all categories including men, women, children, people with disabilities, people from poorest households, people from minority groups, decision makers, opinion leaders, elderly, etc
SF 19: Quality of ODF verification process	A large number of households and OD areas around the village were visited with a large number of participation (70%) of household's members for the verification process

Table 6 (continued)

Sustainability factors	Indicators
SF 20: Existence of post triggering follow-up activities	Percentage of communities with post-triggering follow up support activities, by NGOs, local government, or both
SF 21: Availability/accessibility of sanitation materials and products	Percentage of households that report easy availability of sanitation materials, products, and services (e.g., slabs and masons)
SF 22: Functional monitoring system in place	Percentage of communities with a functional monitoring system in place that triggers corrective action at lowest level

**Fig. 1** Socio-demographic characteristics of villages

3 Results and discussion

3.1 Socio-demographic characteristics of the villages

Figure 1 depicts the socio-demographic characteristics of CLTS villages in Myaing township and PHAST villages in Yesagyo township. Socio-demographic data were gathered to compare the backgrounds of the two project areas, as these backgrounds are likely to impact the projects' long-term viability. There were 2993 households in the CLTS areas and 3436 households in the PHAST areas (Win et al., 2021). The CLTS villages had a population of 13,297, while the PHAST villages had a total population of 13,510 (Win et al., 2021). The project area is located in the Pakokku district, Magway Region, and two

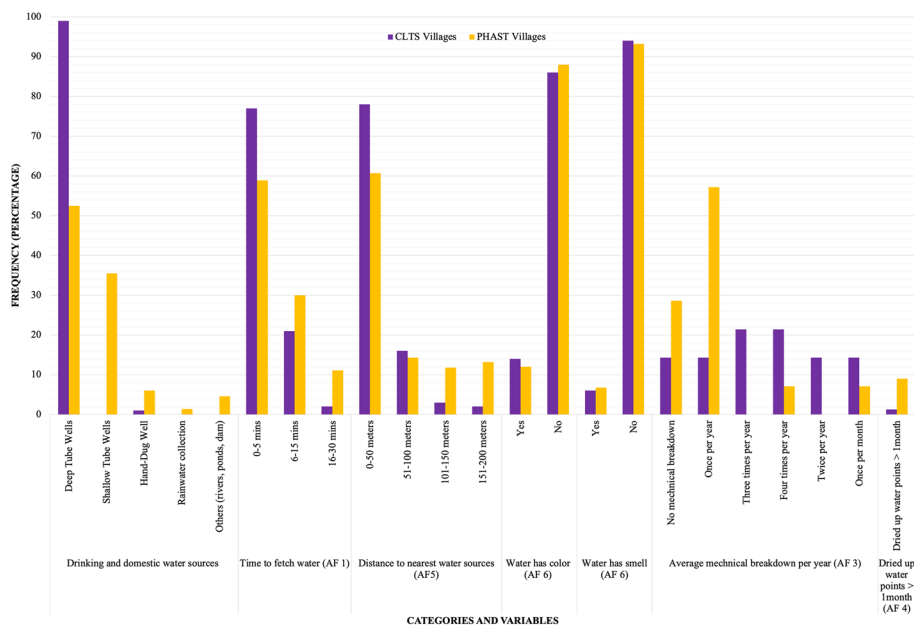


Fig. 2 Sustainability status of water supply in the project areas. *Note:* Relevant area of focus (AF) is indicated in the brackets

townships were approximately 56 km apart. The majority of the ethnic populations who lived in those areas were Burmese and practiced Buddhism. Agriculture and livestock farming were the primary industries in those areas. In both regions, the annual household income ranges from 1,000,000 MMK to > 2,000,000 MMK (Myanmar Kyats). Both project areas were near towns like Pakokku, Myaing, Yesagyo and Mon Ywa. The only significant difference between the two was that project villages in Myaing Township were landlocked, whereas project villages in Yesagyo Township were located alongside streams and rivers. As a result, it is possible to conclude that the two project areas shared similar socio-demographic characteristics.

3.2 Water supply sustainability status

Information on the drinking and domestic water sources in the surveyed communities is presented in Fig. 2. The CLTS communities mostly (99%, 276) relied on deep tube wells and some (1%, 4) on hand-dug wells for their domestic and drinking water supplies. Every household (100%, 280) in the CLTS communities used improved water sources to supply their water needs. In the PHAST villages, 52.5% (147) of families used deep tube wells to obtain their water, 35.5% (99) used hand-dug wells, 6.1% (17) used shallow tube wells, 1.4% (4) collected rainfall, and 4.6% (13) obtained their water from other sources. In the PHAST villages, 95.4% (267) of households used improved water sources for drinking and domestic purposes (Win et al., 2021). Prior to the projects, residents of the CLTS region used ponds for their water supply. In contrast, following the projects, inhabitants utilized deep tube wells, which were more convenient, and only a few houses used their hand-dug

wells. Before the project, only a few households in the PHAST villages used deep tube wells for water; most relied on hand-dug wells and shallow tube wells. Many households had access to deep tube wells when UN-HABITAT undertook the WASH project and built the deep tube wells. Some households, though, continued to use water sources close to their dwellings. The presence of natural water sources reduced the number of households using water from improved water sources. Even though both project sites have sufficient improved water sources, some dwellings in Yesagyo Township opted to use nearby natural water sources. People who lived near rivers assumed that the water was not pure enough to be used for drinking. Some households even favored river water because they considered it to have a superior flavor to other types of water. Water fetching at both project sites ranged from 0 to 30 minutes. The maximum distance between a dwelling and the closest water source was 200 meters. The WASH service providers dispersed the water sources evenly across each project village. Water fetching time was therefore aligned with WHO guidelines, which is no more than 30 minutes (roundtrip), and distance was aligned with the Myanmar National WASH Strategy, which is 200 meters maximum for a one-way trip to fetch water. Hand-dug wells and ponds typically have lower water levels in the summer. With mud in the wells beneath, the water lost clarity and started to smell. Whether the water level is high or low, the water of the ponds is never clear. Because of this, 14.3% (40) of households in the CLTS villages claimed that "the current water had color," while 5.7% (16) of households claimed that "the present water had odor." In the PHAST villages, 6.8% (19) of households and 11.8% (33) of households, respectively, reported "the presence of color and odor in water." In the PHAST villages, 10 villages (71.4%), and in the CLTS villages, 12 villages (85.7%), respectively, had experienced mechanical breakdowns. The communities where the WASH committee frequently checked the pumps and equipment to see if all nuts and bolts were properly tightened and if they had been able to store the appropriate replacement parts, experienced fewer mechanical breakdowns, or none. Depending on the requirements for maintenance, the repair could be completed in a day or two, a week, or a month. In the previous year (2020), only 1% (9) of water sources (ponds) in CLTS project areas and 9% (25) of ponds in PHAST project areas had dried up for longer than a month. Deep tube wells had a lower risk of drying up since they were in confined aquifers and had fewer pumping frequencies. Shallow tube wells and hand-dug wells were also less likely to be dry. Nevertheless, in the dry season, the water level may be lower, which impacts the water quality. Water sources were considered protected if shallow tube wells were placed at least 50 feet from latrine pits; hand-dug wells had an apron and roof to prevent contamination; and ponds had fencing and a jetty to collect water.

Figure 3a–d demonstrates the functionality and protection of water sources in both project areas. The PHAST villages had 97% (157) deep tube wells, 91% (50) hand-dug wells, 83% (25) shallow tube wells, and 53% (17) ponds operating (Win et al., 2021), compared to 94.4% (34) deep tube wells, 100% (2) shallow tube wells, 72.2% (13) hand-dug wells, and 21.1% (4) ponds functioning at the CLTS villages. In the PHAST areas, the ratio of users to water points (particularly for deep tube wells alone) was 1:856, while in the CLTS area, the ratio was 1:391. Dysfunctional deep tube wells and shallow tube wells were observed because mechanical breakdowns occurred during the visit. Some dysfunctional hand-dug wells and ponds were discovered that had been abandoned and were no longer used by the community. In the CLTS area, 100% (4) of ponds, 100% (2) of shallow tube wells, and 15% (2) of hand-dug wells were protected. In the PHAST area, all shallow tube wells (100%), 70% (35) of hand-dug wells, and 82% (14) of ponds were protected (Win et al., 2021). In CLTS areas, hand-dug wells were only used by 1% of the population, so their protection rate was also very low. Only the water points that were currently in use were protected in the PHAST villages. According to the findings,

Fig. 3 Functionality and protection of water sources in project areas. **a** Number of water sources in CLTS villages. **b** Percentage of water sources in CLTS villages. **c** Number of water sources in PHAST villages. **d** Percentage of water sources in PHAST villages. *Note:* Relevant area of focus (AF) is indicated in the brackets

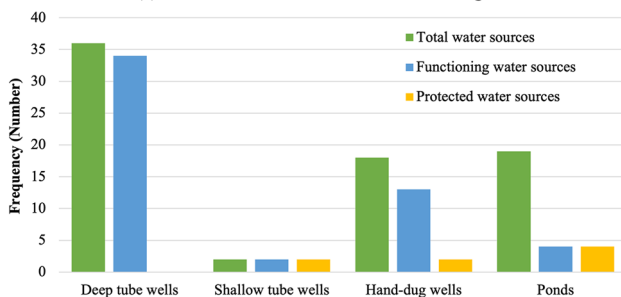
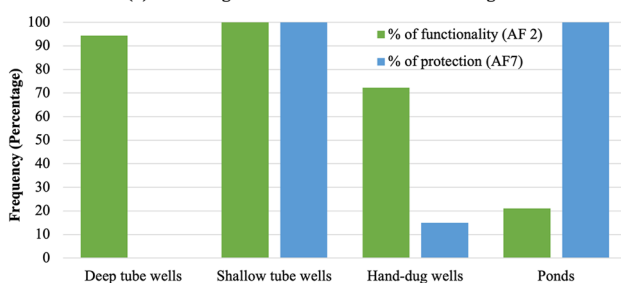
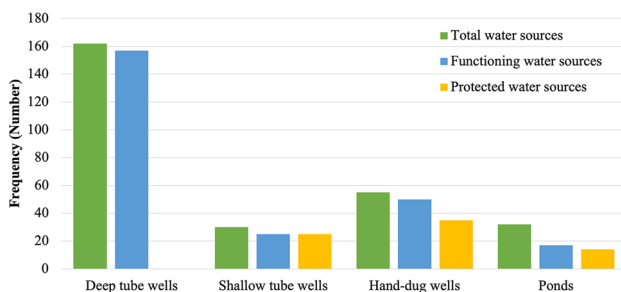
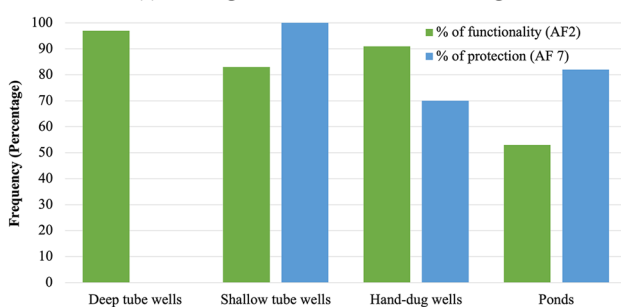
the community uses improved water supplies at a high rate, water fetching times align with WHO criteria, intra-village equity complies with the Myanmar National WASH Strategy, and improved water supply sources are highly functional.

3.3 Sanitation and hygiene sustainability status

Figure 4 displays the status of sanitation and hygiene in both project areas. Despite the lack of subsidies, the CLTS project areas had better access to sanitation than the PHAST project areas, as shown in the figure. However, the use of improved latrine pit facilities, such as concrete latrine pits, was higher in PHAST villages than in CLTS villages. More households in the PHAST villages had concrete latrine pits due to the construction subsidy, which contributed to having high-quality latrine pits. Subsidies were not provided in CLTS villages. Handwashing facilities were also more accessible in the PHAST areas than in the CLTS areas. CLTS areas had higher handwashing practices at critical times except after defecation and before eating. Six open defecation-free (ODF) villages were certified in each project area (42.9%). Agriculture, the main source of income in villages, had an impact on their ODF status. While working in the fields, some households in uncertified ODF villages continued to practice open defecation. In addition, people assumed children's feces are not as dangerous as adults' feces and did not dispose of it safely such as in toilets or by burying it. Parents did not pay much attention to encouraging children to use the toilets. Spreading children's feces around human living environments affected achieving ODF status.

3.4 Sustainability comparison

Table 7 contains the quantitative comparison results of the study's first objective, which was to compare the sustainability of the two project areas. As previously stated in the methodology section, only the indicators that align with the Myanmar National WASH Strategy were compared. Except for the ODF status, both project areas demonstrate the characteristics required for sustainability. Both project areas completely met the sustainable parameters of accessibility and intra-village equity. As a result, people in those areas receive enough water from the evenly distributed water sources, the PHAST project areas having more water sources with adequate quality than CLTS areas. The CLTS areas had slightly higher rates of sanitation facility use and the presence of handwashing facilities. Apart from that, no significant differences were observed between the two project areas despite using two different participatory approaches. Both projects have shown sustainable characteristics. However, it cannot be concluded that the approaches were the only reason for the sustainability status. Other factors that influenced sustainability included sociodemographic characteristics, community readiness for projects, activeness of the community and involvement in project implementation, and the ability of the staff to use the tools and approaches during the intervention period. It was still worth being aware that PHAST projects had been implemented two years before and CLTS projects five years before.

(a) Number of Water Sources in CLTS Villages**(b) Percentage of Water Sources in CLTS Villages****(c) Number of Water Sources in PHAST Villages****(d) Percentage of Water Sources in PHAST Villages**

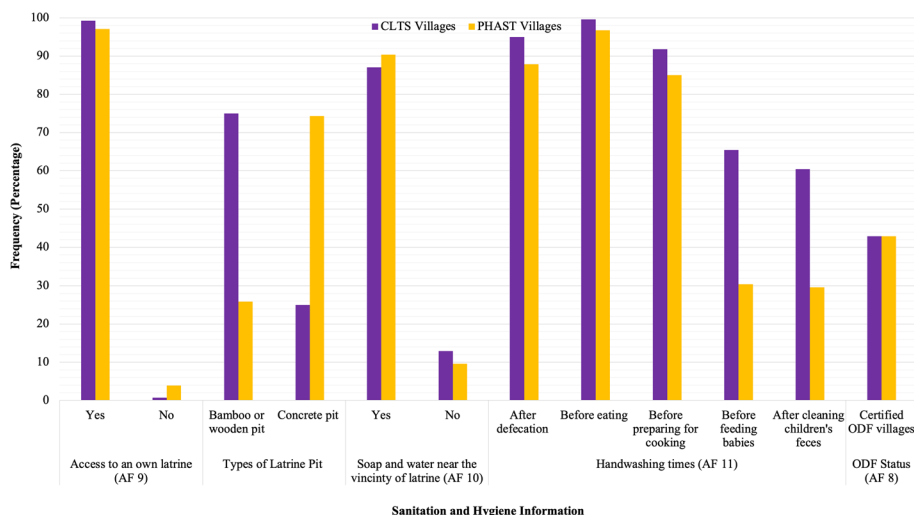


Fig. 4 Sanitation and hygiene information of the project areas. *Note:* Relevant area of focus (AF) is indicated in the brackets

Table 7 Comparing the sustainability of two project areas

Areas of focus	CLTS areas (%)	PHAST areas (%)
AF 1: Accessibility	100	100
AF 5: Intra-village equity	100	100
AF 6: Water Quality	85.7	88.2
AF 8: Maintenance of open defecation-free (ODF) status	42.9	42.9
AF 9: Use of sanitation facilities	99.3	96.8
AF 10: Handwashing facilities	99.3	96.8
AF 11: Handwashing practices	> 80	> 80

4 Contribution to the national strategy

This section highlights the contributions of the CLTS and PHAST project implementation to Myanmar National WASH strategy. This aims to improve the socio-economic status of all rural populations by 2030 by providing equitable, effective, efficient, and affordable water supply, sanitation services, and safe hygiene practices (Government of Myanmar, 2016). It has eight strategic objectives and components: water supply, sanitation, hygiene behavior change, WASH in schools, health facilities, emergencies and humanitarian action, institutional arrangements, and financing to achieve its main strategic goal. Each component has its own set of sub-activities (Government of Myanmar, 2016). The Myanmar national water supply targets for 2030 aim to achieve sufficient water infrastructure in communities, with users to water points (especially deep tube well) ratio of 1:500, with equal distribution within a maximum one way distance of 200 meters from users. Regarding sanitation targets in 2030, the goal is to achieve 100% ODF status for all villages, ensure that 100% of households have access to improved latrines (either individual or shared), provide hand washing facilities to 90% of households, and promote hand washing with

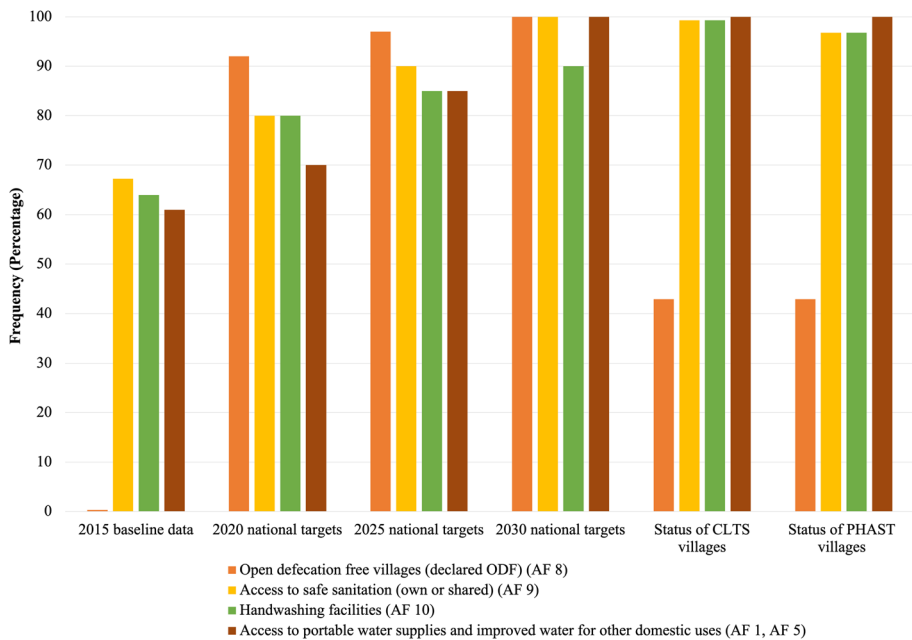


Fig. 5 Water supply and sanitation status of project areas and national targets. *Note:* Relevant area of focus (AF) is indicated in the brackets

soap at critical times for 80% of the population (Government of Myanmar, 2016). Figure 5 displays the baseline data for sanitation and water supply in 2015, as well as the targets for each five years of the strategy in rural areas of Myanmar (Government of Myanmar, 2016) and the current achievement of CLTS and PHAST project areas. Both CLTS and PHAST areas have already reached the water supply targets for 2030. Nonetheless, both areas must continue to work hard to achieve ODF status. As mentioned in Sect. 3.3, barriers exist in main income activities, as well as in people's knowledge and attitudes toward the disposal of children's feces. WASH practitioners must therefore collaborate with mothers, caregivers, persons influencing mothers and caregivers, and children. CLTS areas nearly reached 2030 targets concerning handwashing facilities, whereas PHAST areas had already met 2030 targets.

Activities for WASH in schools, in health care facilities, in emergencies and in humanitarian actions were not observed in either of the project areas. WASH in school activities aims to effectively change community behavior by instilling good hygiene habits in children early on and allowing them to practice at home (UNICEF, 2013). It was created to incorporate WASH lessons and proper hygiene behavior into the curriculum and activities of schools. Older children can pass on those messages to younger siblings, families, and children who do not attend school (Oxfam GB, 2009). The lack of WASH in school activities means missing out on one of the most important activities for achieving ODF status. In light of this, future WASH implementation should integrate this kind of activity. In order to effectively contribute to ending water and sanitation poverty, WASH practitioners and their programs should align with the national strategy of the respective country. Future initiatives should include constructing WASH infrastructure in healthcare facilities, having contingency plans, and providing emergency response training to the WASH committee.

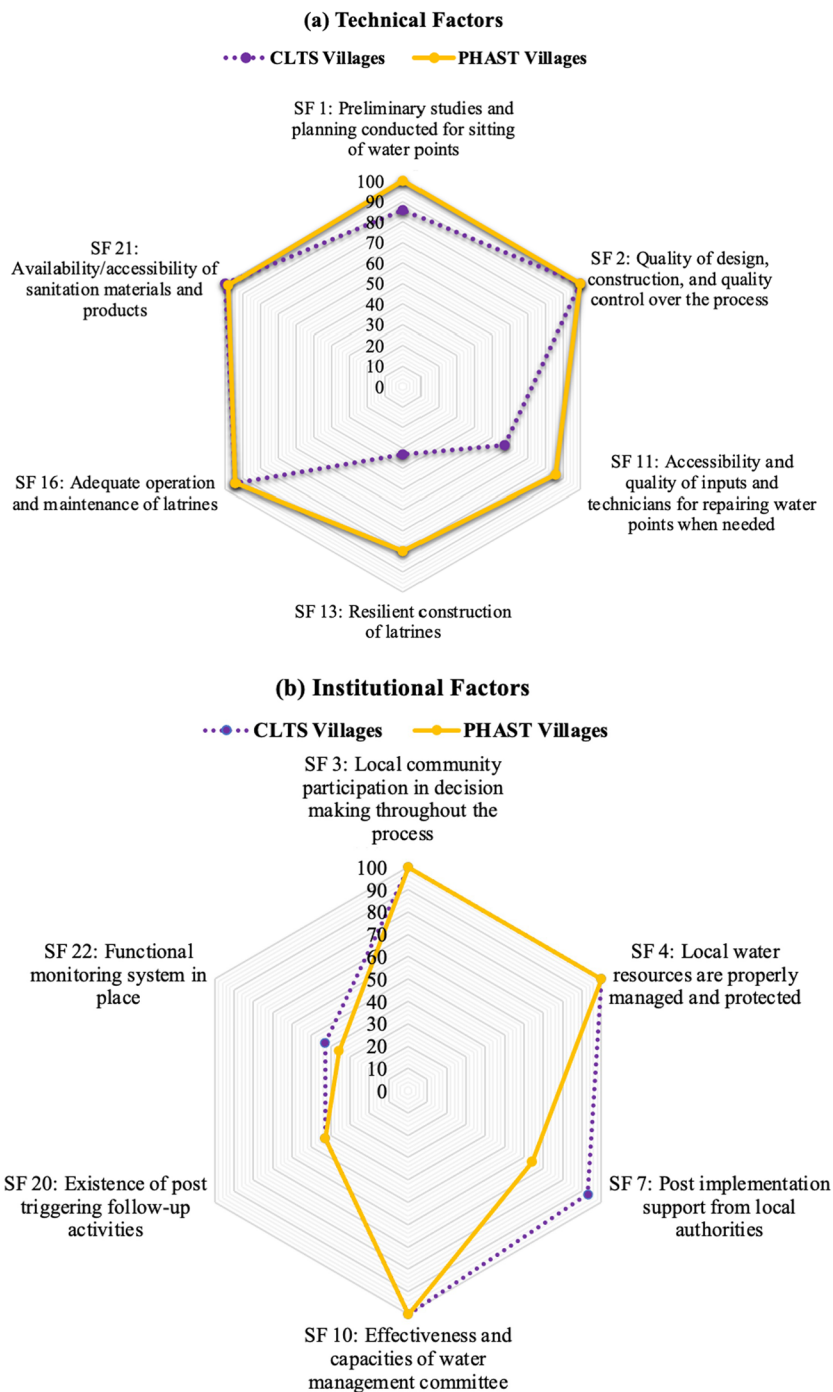


Fig. 6 Sustainability Factors in CLTS and PHAST villages. **a** Technical factors. **b** Institutional factors. **c** Social factors. **d** Financial and sanitation factors

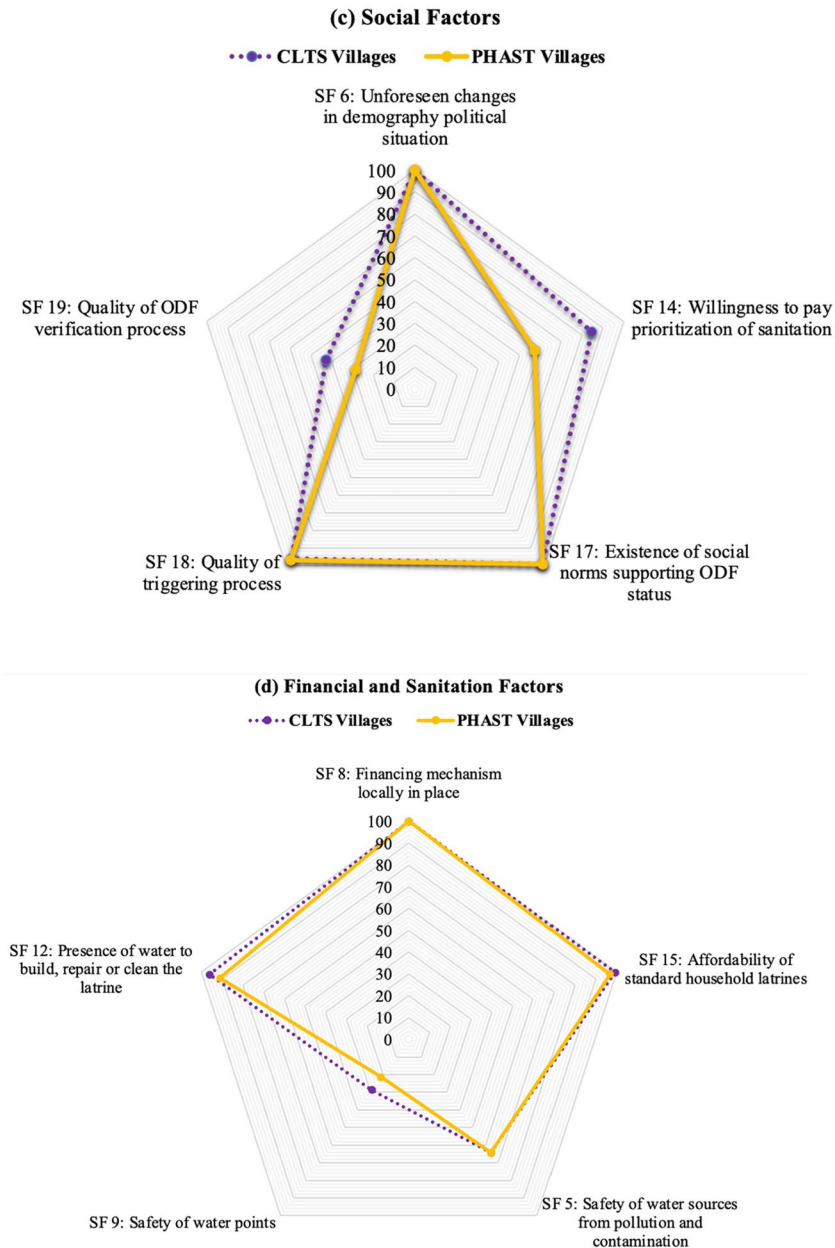


Fig. 6 (continued)

4.1 Sustainability factors in the study area

The sustainability factors observed in all CLTS and PHAST villages were: quality of design and construction (SF 2), local community participation in decision-making throughout the process (SF 3), local water resources properly managed and protected (SF 4), unforeseen

Table 8 Categorization of sustainability factors

Categories	Sustainability factors
Technical	SF 1: Preliminary studies and planning conducted for siting of water points SF 2: Quality of design, construction, and quality control over the process SF 11: Accessibility and quality of inputs and technicians for repairing water points when needed SF 13: Resilient construction of latrines SF 16: Adequate operation and maintenance of latrines SF 21: Availability/accessibility of sanitation materials and products
Institutional (Community level)	SF 3: Local community participation in decision making throughout the process SF 4: Local water resources are properly managed and protected SF 7: Post implementation support from local authorities SF 10: Effectiveness and capacities of water management committee
Institutional (local government level)	SF 20: Existence of post triggering follow-up activities SF 22: Functional monitoring system in place
Social	SF 6: Unforeseen changes in demography political situation SF 14: Willingness to pay prioritization of sanitation SF 17: Existence of social norms supporting ODF status SF 18: Quality of triggering process SF 19: Quality of ODF verification process
Financial	SF 8: Financing mechanism locally in place SF 15: Affordability of standard household latrines
Sanitation	SF 5: Safety of water sources from pollution and contamination SF 9: Safety of water points SF 12: Presence of water to build, repair or clean the latrine

changes in demography and political situation (SF 6), financing mechanism locally in place (SF 8), effectiveness and capacity of the water management committee (SF 10). The factors which occurred in the majority of the villages (> 80%) are preliminary studies and planning conducted for siting of the water points (SF 1); presence of water to build, repair or clean latrines (SF 12); affordability of standard household latrines (SF 15); adequate operation and maintenance of latrines (SF 16); existence of social norms supporting ODF status (SF 17); quality of triggering process (SF 18); and availability/accessibility of sanitation materials and products (SF 21).

The safety of water sources from pollution and contamination (SF 5) was observed in more than half of the villages (64.3%). The remaining factors, which were less than 50%, were: the safety of water points (SF 9), the quality of the ODF verification process (SF 19), the existence of post-triggering follow-up activities (SF 20), and functional monitoring system in place (SF 22). The presence of post-implementation support from local authorities (SF 7) and willingness to pay for the prioritization of sanitation (SF 14) were higher (> 30%) in CLTS villages. Due to the way the CLTS approach works, it inspires a desire for total sanitation and encourages neighboring communities to cooperate in cleanup efforts. Instead of funding physical infrastructure development (such as latrines), CLTS invests in community mobilization and awareness-raising efforts and engages with the relevant government department (Kar & Chambers, 2008). In contrast, PHAST villages had better accessibility and quality of inputs, and technicians were available to repair water points when needed (SF 11) and resilient construction of latrines (SF 13). Because PHAST communities received subsidies to build latrines, WASH committees were formed and provided operation and maintenance (O&M) training and the necessary toolkits for water point repair. Figure 6a–d summarize all of the information mentioned above.

Sustainability factors can be grouped into five categories: technical factors, institutional factors, social factors, financial factors and sanitation factors. There are two subcategories for institutional factors: community level and local government level. Details of these factors are provided in Table 8.

In the study areas, high scores were achieved for technical factors, institutional factors (community level), social factors except the quality of ODF verification process (SF 19), financial factors, and sanitation factors: presence of water to build, repair or clean latrines (SF 12). Although technical factors had a high score, no advanced technology was applied in CLTS and PHAST villages. Instead, locally appropriate technology and materials readily available in local markets were used. Regarding the institutional factors, only the community-level factors had high scores, while local government-level factors had low scores. This demonstrates that, while international and national non-governmental organizations were working to achieve the goals of the National WASH Strategy, local authorities were not equipped to provide the necessary support. On the other hand, the community was ready to receive services from the organizations. At the local government level, capacity gaps have occurred. To strengthen local government abilities, capacity building and raising awareness about the national WASH strategy should be carried out. Except for the quality of the ODF verification process, the social factor received high scores (SF 19). It appeared that gaps occurred between organizations and the community when implementing this activity, for example, when it was conducted during the peak season of agriculture, such as ploughing and/or harvesting time. Regarding sanitation factors, the presence of water to build, repair, or clean the latrine (SF 12) received a high score because both CLTS and PHAST villages had sufficient water resources. However, the organizations gave more emphasis to the construction of water points, operation, and maintenance of the water points, and providing protective measures such as fencing, roofs and drainage to the existing water points rather than carrying out detailed measures of water safety plans (WSP) during the limited implementation period. This resulted in a medium score for the safety of water sources from pollution and contamination (SF 5). Local governments did not implement WSP under their jurisdiction.

4.2 Consistency with previous studies

These findings are consistent with the sustainability framework proposed by the Dutch WASH Alliance (WASH Alliance International, 2016). According to Daniel et al. (2021), technical, institutional, social, financial, and environmental factors interact with each other and can influence the sustainability of WASH services (Daniel et al., 2021). The findings about technical factors, including the use of good quality construction materials, community participation in the installation of water points, community participation in the planning stage to choose affordable technology, and community capacity to maintain WASH services, were consistent with previous findings by Muhumed (2013) and Kativhu et al. (2018). The results regarding institutional factors are coherent with Marks et al., (2014). The depth of community participation, such as planning meetings before the construction, is positively associated with the sustainability of water sources and skills. The capacity of the WASH committee to carry out water and sanitation tasks impacts WASH service sustainability as the WASH committee is the highest management institution discovered at the community level (Kativhu et al., 2018). Financial factors such as the presence of financing mechanisms to carry out regular operations and maintenance are congruent with Muhumed (2013).

5 Conclusions and recommendations

This study assessed the sustainability (long-term impacts of WASH projects) of community-led total sanitation (CLTS) projects and participatory hygiene and sanitation transformation (PHAST) projects using indicators of Sustainability Check such as accessibility, intra-village equity, water quality, maintenance of open defecation-free (ODF) status, hand-washing facilities, and handwashing practices, etc. Results indicated that some indicators, such as accessibility and intra-village equity, were fully achieved. Other indicators achieved more than 80% and had already attained national hygiene and sanitation targets, except for the ODF status. Although the local government's support level was notably insufficient, the CLTS projects, implemented five years ago, and PHAST projects, implemented two years ago, still demonstrated sustainability and achieved national targets in terms of water supply (accessibility and intra-village equity), usage of latrines, presence of hand-washing facilities, and handwashing practices. No significant differences were observed between CLTS and PHAST villages in terms of accessibility, intra-village equity, water quality, maintenance of ODF status, use of sanitation facilities, handwashing facilities, or handwashing practices.

This study also evaluated the factors influencing on the sustainability such as quality of design, construction, and quality control over the process, local community participation in decision making throughout the process post implementation support from local authorities, willingness to pay prioritization of sanitation, etc. as suggested by Sustainability Check. The results indicates that all the sustainability factors are present in the study areas. However, some sustainability factors scored higher in CLTS or PHAST villages. For example, scores for post-implementation support from local authorities and willingness to pay prioritization of sanitation were over 30% higher in CLTS villages. Conversely, scores for accessibility and quality of inputs and technicians for repairing water points and resilient construction of latrines were over 30% higher in PHAST villages.

Finally, five measures are recommended to enhance the sustainability of WASH projects in Myanmar as follows.

The first measure is to foster interaction and coordination with key government departments to ensure long-term success and community support. WASH service providers need to establish closer collaboration with key government departments, such as public health, rural development, and education. Facilitating the project handover to these departments at the community level will ensure further necessary assistance and follow-up, thereby contributing to the sustainability action.

The second measure is to encourage community participation and foster sense of ownership. Active participation of both men and women in the decision-making process, technology selection, and construction design increases community members' awareness of the benefits and drawbacks associated with their choices, thereby fostering a lifelong commitment to maintaining WASH services. Strategic scheduling should be employed to maximize community participation in critical activities such as triggering events and ODF verification processes. The WASH service provider needs to consider the community's seasonal calendar to determine suitable timing that aligns with community members' availability, minimizing conflicts with their livelihood activities. To ensure ongoing community engagement, it is recommended that WASH service providers maintain the current practice of conducting meetings with WASH committees and users before installing water points. The collaborative decision-making approach to material selection within the available budget empowers the community. Furthermore,

encouraging community participation throughout all stages of the project cycle (planning, implementation, monitoring, and evaluation) by providing a budget and a brief project description allows community members to actively select high-quality materials available in the local market for operation and maintenance (O&M) purposes.

The third measure is to empower community-based bodies for O&M and monitoring of water and sanitation facilities. WASH service providers should offer comprehensive training to WASH committees on O&M practices and financial management. Equipped with these skills, water committees can efficiently manage water tariffs and expenditures, providing regular financial updates to water users, ideally every quarter. This accountable and transparent mechanism strengthens trust between users and the water management committee. Before the project phasing out, it is recommended to establish close collaboration between the WASH service provider and the committee members to facilitate routine monitoring and maintenance of WASH facilities. Upon the project completion, the WASH committee should take exclusive responsibility for the operation and maintenance. Additionally, establishing a water tariff system within each community and promoting regular user payment would be another important recommendation for the project's sustainability.

The fourth measure is to integrate appropriate behavioral change activities to promote good water, sanitation and hygiene practices. The study revealed that few population continued to use water from unimproved sources due to a preference for its taste, despite the accessibility of improved water facilities. WASH practitioners are encouraged to be aware of the local context and cultural beliefs of the community they work with, and to incorporate relevant behavioral change initiatives to address this issue effectively.

The last measure is to align with the National WASH Strategy incorporating WASH activities in schools, health facilities, and community waste management within future project implementation. Furthermore, a comprehensive emergency response plan should be developed to address potential threats from natural disasters that could jeopardize the sustainability of WASH facilities. Moreover, verifying ODF status should be integrated into new WASH project implementation activities, as it represents a primary goal of the Myanmar National WASH Strategy.

Future studies should consider comparing sustainability of alternative project implementation approaches such as sanitation marketing or mix of different approaches, in addition to the traditional CLTS and PHAST methods for WASH projects. Sanitation marketing was created based on successful practices in areas like social marketing and behavior change communication (BCC). The integration of CLTS and sanitation marketing has effectively reduced open defecation rates, as evidenced by the work of Devine and Kullmann (2011). Undertaking such studies would significantly contribute to achieving Myanmar National WASH Strategy.

Availability of data and materials The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request. **Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

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